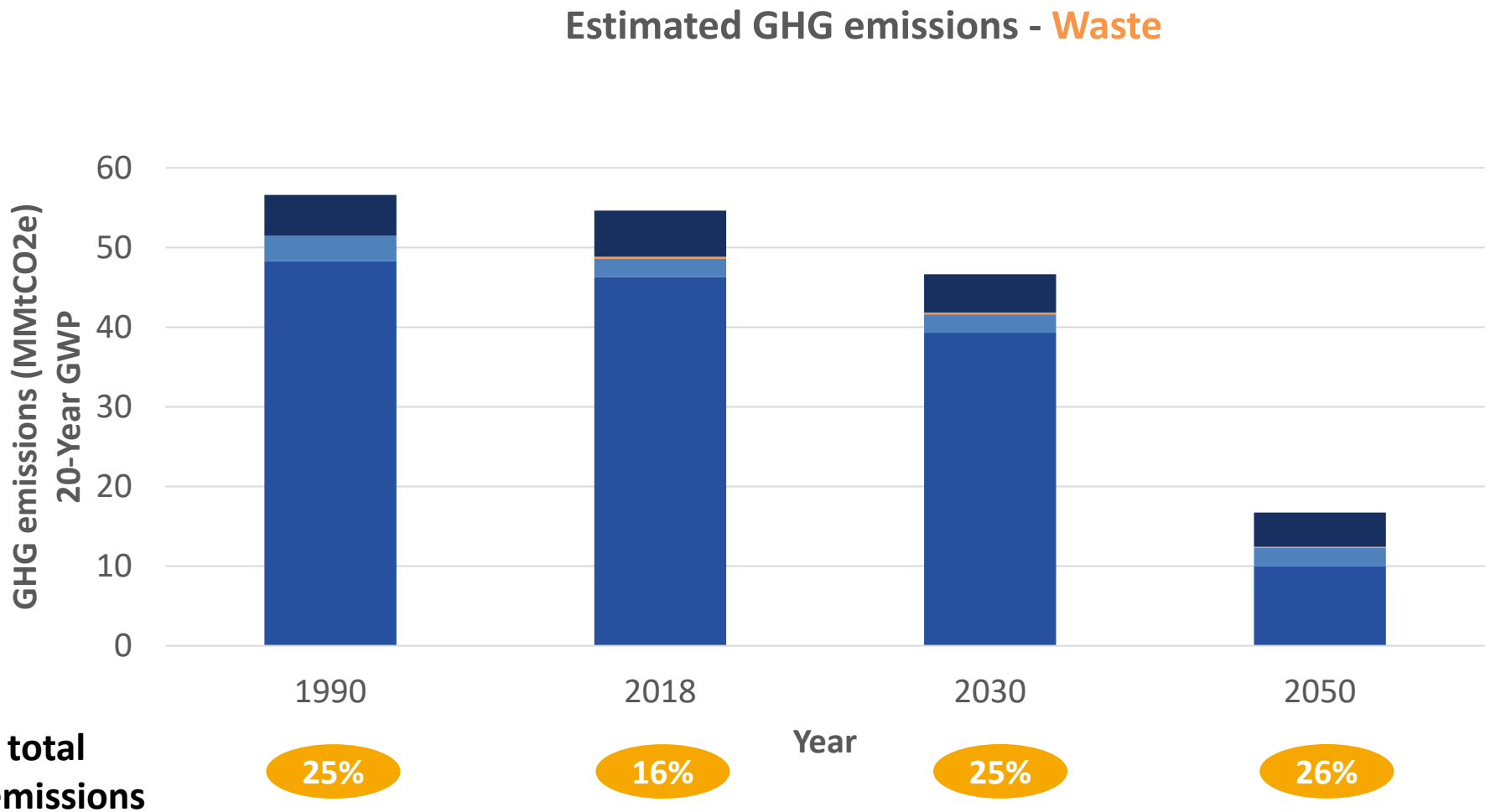
Waste Advisory Panel

Recommendations

April 5, 2021

NEW YORK STATE OF OPPORTUNITY. Climate Action Council

Aggregate GHG emissions impact of Waste panel recommendations



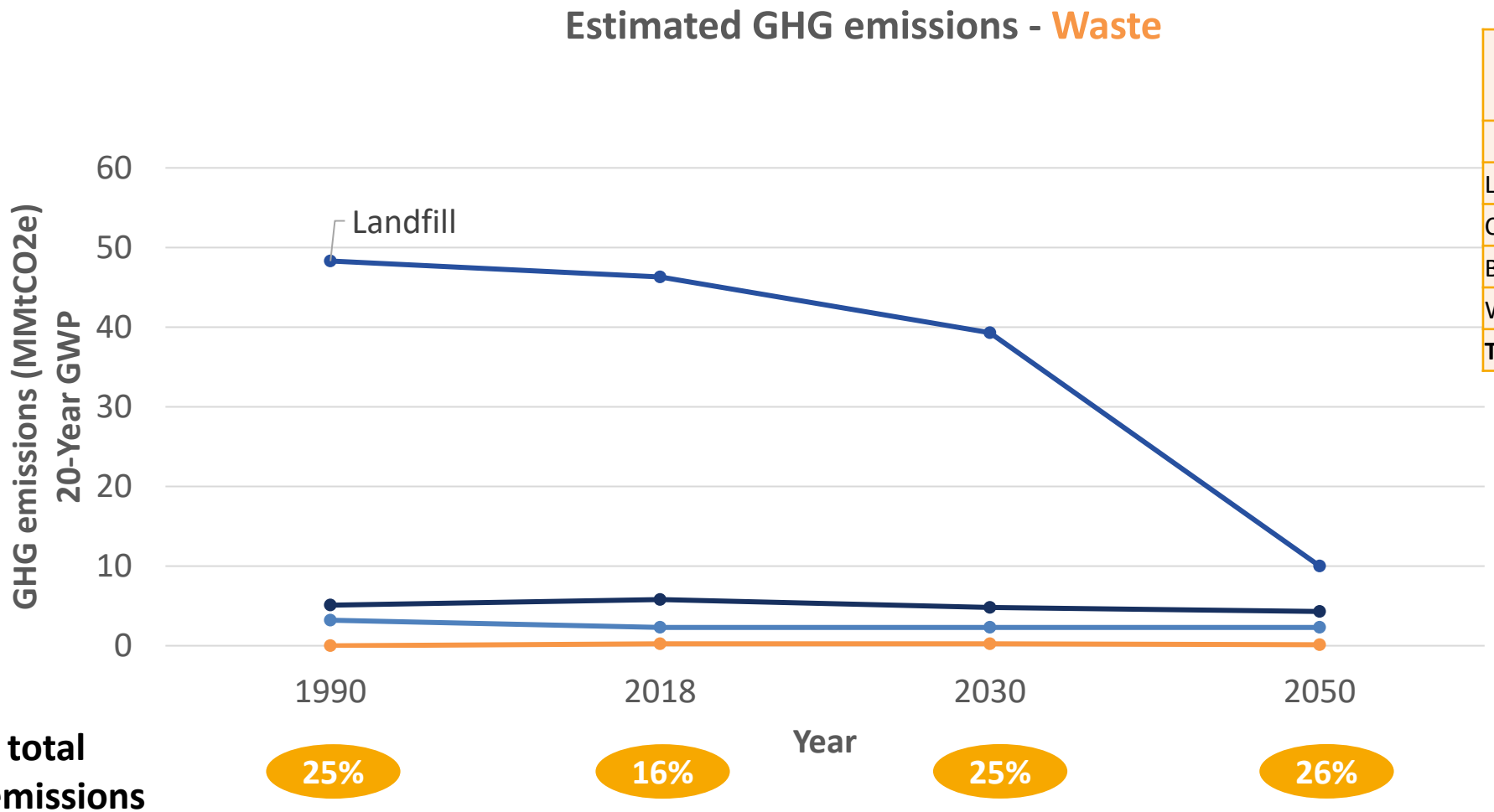
Reductions require aggressive initiatives to divert organics from landfills and reduce methane leaks.

% of total NY emissions

25% 16% 25% 26%

2018 emissions data are preliminary draft

Aggregate GHG emissions impact of Waste panel recommendations



Total reductions in GHG emissions from 1990		
	2030	2050
Landfill	18.6%	79.3%
Combustion	28.1%	28.1%
Biological	(increase)	(increase)
Wastewater	5.9%	15.7%
Total all sectors	17.6%	70.5%

% of total NY emissions

25% 16% 25% 26%

2018 emissions data are preliminary draft

Actions needed to achieve GHG emissions reductions

- Landfills
  - Achieving the aggressive goals of *Beyond Waste*, the New York State Solid Waste Management Plan (e.g., 90% paper recycling and 65% food waste diversion by 2030)
  - Delay in achieving GHG emissions reductions due to typical slow rate of degradation of waste placed in landfills
- Combustion
  - No reduction projected from 2018-2050 because existing combustor facilities will be needed to handle MSW remaining after reduction, reuse, and recycling strategies
- Biological (composting, regional anaerobic digesters)
  - 50% of current leaks eliminated by 2030; 75% by 2050
- Wastewater
  - 50% of current anaerobic digester leaks eliminated by 2030; 75% by 2050
  - 1/3 of fugitive emissions from WRRFs eliminated by 2030; 2/3 by 2050
  - 1% increase in municipal sewer system utilization (conversion from septic) by 2030; 2% by 2050

Mitigation strategy summary

Initiative #	Description	Action type	Emissions impact	Ease of implementation	Cost
1	Reduce methane and carbon dioxide emissions by reducing the combustion and landfilling of organics and other methane/GHG producing wastes.	Legislative; Regulatory; Financial	High	Easy	$$
2	Reduce methane and carbon dioxide emissions from waste disposal facilities by enacting broad Extended Producer Responsibility (EPR)/Product Stewardship requirements to cover the recycling of packaging and printed paper, carpet, tires, textiles, solar panels, wind turbines, all batteries, appliances (especially those containing refrigerants), mattresses, and other methane generating wastes.	Legislative	High	Easy to Medium	$$
3	Identify and reduce fugitive emissions of methane from landfills and anaerobic digesters through baseline measurement, increased monitoring, and engineering and regulatory programs to reduce leaks.	Regulatory	High	Easy to Medium	$

Mitigation strategy summary

Initiative #	Description	Action type	Emissions impact	Ease of implementation	Cost
4	Reduce methane and carbon dioxide emissions from landfills and combustors by supporting domestic recycling facilities and markets for recovered resources, including compost, digestate, and recycled aggregate/building deconstruction materials.	Legislative; Financial	Medium	Easy to Medium	$ - $$
5	Recognizing that some waste generation is unavoidable, determine limited and strategic best uses for energy produced from biogas/RNG derived from organic waste. Assess use in the waste transportation sector, electric co-location or cogeneration opportunities for energy/heat intensive industries and hard to electrify users. Utilize market value of the energy to support organics diversion and waste reduction initiatives. Align energy price analysis with funding needs for build-out of organics recycling infrastructure.	Legislative; Financial	Medium to High	Medium	$$

Mitigation strategy summary

Initiative #	Description	Action type	Emissions impact	Ease of implementation	Cost
6	Reduce methane and carbon dioxide emissions from waste disposal facilities by supporting robust waste reduction, reuse, and recycling initiatives.	Legislative; Financial	Medium	Easy	$
7	Transform Wastewater Treatment Plants from waste disposal priority to Water Resource Recovery Facilities (WRRFs) that emphasize capture of beneficial products.	Financial	High	Medium	$$
8	Measure and reduce fugitive emissions from WRRFs, septic and sewer systems. Where density and local conditions allow, eliminate septic tanks and convert to municipal sewer system collections or advanced onsite treatments.	Legislative; Regulatory; Financial	High	Easy to Medium	$$
9	Reduce GHG emissions associated with end-of-life management of appliances that contain High-Global Warming Potential refrigerants. Benefits are highest in the near-term while these refrigerants are still in widespread usage.	Legislative; Regulatory	Medium to High	Easy	$

Mitigation strategy – Initiative #1: Organic Waste Reduction and Recycling

Description:	Reduce methane and carbon dioxide emissions by reducing the combustion and landfilling of organics and other methane/GHG producing wastes.		
Action type:	Legislative; Regulatory; Financial		
GHG reduction by 2030:	High	**GHG reduction by 2050:**	High
Cost and funding considerations:	$$; Cost are associated with the development of infrastructure for additional food donation, increased food scraps recycling, and organics handling. However, costs are shifted from waste disposal.		
Ease of implementation:	Easy; The technologies exist, the challenges are financial (e.g., investment & end markets), behavioral, and logistical (e.g., siting, etc.).		
Example case studies:			

Risks / Barriers to success	Possible mitigants
• The relatively low cost of landfilling make alternatives less attractive • Capacity and economically viable markets must exist for compost, biogas, digestate, and other organics products. • Requires significant and broad-based behavior change. • May create impacts in transportation and handling. • Presence of co-pollutants including emerging contaminants.	• As more organics recycling facilities and collection systems are established the cost should become more competitive. • Successful food scraps recycling systems already exist and can be replicated. • Low carbon approaches to collection and transportation. • Reliable end markets / market outlets. • Tip fee surcharge important to establishing funding sources.

Mitigation strategy – Organic Waste Reduction and Recycling

Components required for delivery *(Brief description of action required)*	**Implementation lead** *(Entity responsible for completing)*	**Time to implement** *(Time required to implement)*	**Other key stakeholders** **(***Entities that need to be engaged)*
Expand and Amend existing Food Donation and Food Scraps Recycling Law to include smaller food scraps generators, eliminate or increase mileage limit for organics recycling facilities and eliminate the financial hardship exemption.	Legislative	1-2 years increase requirements of existing law	DEC, food generators, DOH, DAM, donation organizations, SWMFs
Phase in organics source separation requirements and eventual ban on the combustion and landfilling of food scraps, food processing wastes, and other high-strength and organic wastes.	DEC	5-10 years phase in source separation and full ban	"
Require a surcharge (fee per ton) on all waste landfilled or combusted in New York State and all waste generated in New York State being sent for landfilling or combustion out-of-state to provide financial support for reduction, reuse, and recycling projects.	Legislative	1-2 years	DEC, solid waste management facilities (SWMFs), municipalities
Provide financial assistance for emergency food relief organizations and organics recycling facility infrastructure. Encourage partnerships between retailers and donation organizations for food and other household products.	DEC	1 year	SWMFs, food recovery organizations

Mitigation strategy – Organic Waste Reduction and Recycling

Components required for delivery *(Brief description of action required)*	**Implementation lead** *(Entity responsible for completing)*	**Time to implement** *(Time required to implement)*	**Other key stakeholders** (*Entities that need to be engaged)*
Financial assistance to expand food scraps drop-off and local-scale processing opportunities (e.g., farmers markets, community gardens, transfer facilities, etc.). Financial assistance for local, non-profit, and small-scale organics collection and processing systems.	DEC; DAM	1-2 years	Municipalities, small-scale solid waste management facilities (SWMFs) and transporters, farmers
Financial assistance, education, and outreach to schools for food waste reduction, food donation, and on-site food scraps recycling programs.	DEC; NYSED	2-3 years	NYSED, municipalities, schools
Provide incentive for public-private partnership for organics recycling facility development.	DEC; ESD	2-3 years	Municipalities, SWMFs
Encourage co-location of solid waste infrastructure investments and operation by simplifying regulatory requirements and incorporate into local planning.	DEC; Legislative	1-3 years	SWMFs

Mitigation strategy – Organic Waste Reduction and Recycling

Components required for delivery *(Brief description of action required)*	**Implementation lead** *(Entity responsible for completing)*	**Time to implement** *(Time required to implement)*	**Other key stakeholders** **(***Entities that need to be engaged)*
Require local solid waste management planning units to emphasize food scraps recovery programs.	DEC	1 year	Municipalities, local solid waste planning units
Food waste reduction education and outreach to businesses and residents. Evaluate and define food labelling and portion practices (including “best by dates”, meal planning, etc.) to reduce waste. Implement “best by” food label standardization.	Legislative; DEC	1-2 years	Residents, businesses, solid waste management facilities, retailers, manufacturers
Support reducing food waste in stores via enhanced demand planning systems (digital), minimized in-store inventory, dynamic pricing near expiry, and reduced portion size of food sales. Program to be coupled with education materials in stores and GHG smart shopping tips.	DEC	1-3 years	Retail, groceries, digital inventory apps

Mitigation strategy – Organic Waste Reduction and Recycling

Components required for delivery *(Brief description of action required)*	**Implementation lead** *(Entity responsible for completing)*	**Time to implement** *(Time required to implement)*	**Other key stakeholders** **(***Entities that need to be engaged)*
Evaluate the co-location of food donation and compost sites for streamlined waste diversion. Support installation of renewable energy projects (solar, wind, battery) to power refrigeration at donation sites for produce and perishable goods.	Legislative	1-5 years	Food donation organizations, businesses, municipalities
Expand successful models for organics collection programs inclusive of multi-family buildings and public housing (e.g., NYCHA, etc.).	DEC; housing authorities	1-3 years	Municipalities
Fund digital platforms for donation logistics and operation including efficient transportation route planning, food safety monitoring, reusable storage solutions where feasible, etc.	Legislative	1-5 years	Food donation organizations, businesses, municipalities

Mitigation strategy – Organic Waste Reduction and Recycling

Components required for delivery *(Brief description of action required)*	**Implementation lead** *(Entity responsible for completing)*	**Time to implement** *(Time required to implement)*	**Other key stakeholders** **(***Entities that need to be engaged)*
Require thoughtful food waste reduction and education strategies in school meals. Consider GHG impacts in purchasing of products selected for consumption. Enhance compost and waste diversion education standards in schools for early habit adoption.	Legislative; NYSED	1-5 years	Municipalities, schools
Support technology-enabled waste tracking in restaurants.	DEC	1-3 years	DEC, restaurants
Land use and procurement for non-profit, small-scale composters: Require that composting is explicitly allowed, and encouraged, on municipal park lands.	Legislative; DEC	1-3 years	Parks
Increase the ability to distribute organic amendments locally: Establish local compost receiving partners with food growers, street tree, stormwater resiliency projects, individuals, etc.	DEC	1-3 years	Municipalities, solid waste management facilities

Mitigation strategy – Organic Waste Reduction and Recycling

Anticipated Benefits and Impacts	
Disadvantaged communities	Solid waste combustion and landfill facilities may be located in EJ and disadvantaged communities. Food waste in these facilities leads to odors that significantly impact quality of life for those communities and potential health impacts. Removing food waste will reduce truck traffic to the landfill and odors.
Health and co-benefits	Odors from landfills and transfer facilities have an impact on neighboring communities, and exposure to odors could result in health impacts. Reducing these odors will improve air quality and may reduce health impacts in these communities.
Just transition: businesses and industries, workers	Increasing food donation will assist those in need and increasing food waste recycling will increase job opportunities, including local jobs for recycling facilities located close to the source.
Other	The technologies are readily available if the requirements, financing, and end markets are available.

Mitigation strategy – Initiative #2: Extended Producer Responsibility/Product Stewardship

Description:	Reduce methane and carbon dioxide emissions from waste disposal facilities by enacting broad Extended Producer Responsibility (EPR)/Product Stewardship requirements to cover the recycling of packaging and printed paper, carpet, tires, textiles, solar panels, wind turbines, all batteries, appliances (especially those containing refrigerants), mattresses, and other methane generating wastes.		
Action type:	Legislative		
GHG reduction by 2030:	High	**GHG reduction by 2050:**	High
Cost and funding considerations:	$$; Funding will be provided by the product manufacturers.		
Ease of implementation:	Easy to Medium		
Example case studies:	Successful current beverage container, electronic waste, thermostat, and battery programs in New York State.		

Risks / Barriers to success	Possible mitigants
• May require the development of infrastructure to collect and recycle. • Manufacturers are located across the globe. • Certain industries may oppose taking responsibility or will cite successful recycling models already in place (e.g., paper and packaging manufacturers).	• Successful programs in New York State and elsewhere already exist using this model.

Mitigation strategy – Extended Producer Responsibility/Product Stewardship

Components required for delivery *(Brief description of action required)*	**Implementation lead** *(Entity responsible for completing)*	**Time to implement** *(Time required to implement)*	**Other key stakeholders** **(***Entities that need to be engaged)*
Legislation to create a framework for extended producer responsibility/product stewardship, or individual legislation targeting products with the greatest greenhouse gas impact (e.g., packaging and printed paper, carpet, tires, textiles, solar panels, wind turbines, all batteries, appliances (especially those containing refrigerants), mattresses, etc.)	Legislative	1-5 years	DEC, product manufacturers

Mitigation strategy – Extended Producer Responsibility/Product Stewardship

Anticipated Benefits and Impacts	
Disadvantaged communities	Reduction in landfilling will also reduce the need for transfer facilities and will reduce truck traffic that can impact EJ and disadvantaged communities. These facilities can significantly impact quality of life for those communities and potential health impacts.
Health and co-benefits	Reduction in truck traffic and transfer facilities can reduce emissions and will improve air quality in these communities. Reduction in illegal dumping by providing convenient methods of recycling.
Just transition: businesses and industries, workers	Requiring manufacturers to establish collection systems for recycling will lead to local jobs associated with those collection systems.
Other	Requiring manufacturers to take responsibility for materials management leads to product designs that have less waste at the end of their useful life. Solar panels and large-scale batteries are more of a concern for end-of-life management of renewable energy technologies that are expected to grow exponentially under the CLCPA. Currently no widely available options exist for end-of-life management of these items.

Mitigation strategy – Initiative #3: Reduce fugitive emissions

Description:	Identify and reduce fugitive emissions of methane from landfills and anaerobic digesters through baseline measurement, increased monitoring, and engineering and regulatory programs to reduce leaks.		
Action type:	Regulatory		
GHG reduction by 2030:	High	**GHG reduction by 2050:**	High
Cost and funding considerations:	$		
Ease of implementation:	Easy to Medium		
Example case studies:	California Methane Study (“Super-Emitter Study”)		

Risks / Barriers to success	Possible mitigants
• Current monitoring of fugitive emissions from landfills and ADs are not robust and full emissions data are lacking. • Fugitive emission levels likely vary significantly among individual facilities (e.g., California Super-Emitter Study).	• Monitoring technologies continue to improve. • Total number of landfill facilities anticipated to drop over time as facilities close or are repurposed for organics processing. • Existing financial limitations of the facilities and municipalities.

Mitigation strategy – Reduce fugitive emissions

Components required for delivery *(Brief description of action required)*	**Implementation lead** *(Entity responsible for completing)*	**Time to implement** *(Time required to implement)*	**Other key stakeholders** **(***Entities that need to be engaged)*
Incorporate improved monitoring technologies (e.g., drones) into facility operations and existing monitoring programs.	DEC	1-5 years	Solid waste management facilities
Implement best practices for further emissions reduction. • Landfill examples: enhanced landfill covers to increase oxidation of methane, specialty landfill gas collectors for difficult to access areas, dewatering to increase collection. • AD examples: improve maintenance on methane collection systems.	DEC	1-5 years	Solid waste management facilities
DEC regulation changes for landfills to require installation of landfill gas collection systems sooner after waste placement; expansion of monitoring requirements for fugitive emissions beyond existing criteria.	DEC	1-3 years	Solid waste management facilities

Mitigation strategy – Reduce fugitive emissions

Anticipated Benefits and Impacts	
Disadvantaged communities	Landfills may be located in EJ and disadvantaged communities. Increased methane collection rates reduce the potential for odors or impacts from emissions.
Health and co-benefits	Emissions lead to odors and potential health impacts which have a significant impact on neighboring communities. Reducing these leaks will improve air quality and may reduce health impacts in these communities.
Just transition: businesses and industries, workers	Projects produce energy, jobs, co-located facilities, and opportunities for partnerships with industries needing energy and/or heat.
Other	Fugitive emissions data will focus regulatory and industry resources at the specific facilities or areas where the greatest improvements can be made.

Mitigation strategy – Initiative #4: Recycling markets

Description:	Reduce methane and carbon dioxide emissions from landfills and combustors by supporting domestic recycling facilities and markets for recovered resources, including compost, digestate, and recycled aggregate/building deconstruction materials.		
Action type:	Legislative; Regulatory; Financial		
GHG reduction by 2030:	Medium	**GHG reduction by 2050:**	Medium
Cost and funding considerations:	$ - $$		
Ease of implementation:	Easy to Medium		
Example case studies:	Onondaga Resource Recovery Agency's solid waste management facilities have public-private partnerships; existing OGS green procurement rules; ESD has previously assisted with funding recycling markets (e.g., glass, tires, etc.)		

Risks / Barriers to success	Possible mitigants
• Commodities markets are global and subject to severe capacity and price fluctuations. • Markets may exist but the price paid is not enough to sustain the cost of material collection and processing.	• Growth in domestic markets will reduce volatility in market pricing. • Domestic market pricing can be increased by subsidies, source separation requirements and other means.

Mitigation strategy – Recycling markets

Components required for delivery *(Brief description of action required)*	**Implementation lead** *(Entity responsible for completing)*	**Time to implement** *(Time required to implement)*	**Other key stakeholders** **(***Entities that need to be engaged)*
Require a surcharge (fee per ton) on all waste landfilled or combusted in New York State and all waste generated in New York State being sent for landfilling or combustion out-of-state to provide financial support for reduction, reuse, and recycling projects.	Legislative	1-2 years	DEC, solid waste management facilities, municipalities
Financial assistance to develop recycling markets.	Legislative	1-4 years	DEC, solid waste management facilities, municipalities
Financial assistance to research and increase the capture and use of building deconstruction materials and recovered aggregate for a variety of applications. Change government requirements (e.g., procurement standards, bid specifications, etc.) to include recycled or reused deconstruction materials.	DEC	1-4 years	DOT, solid waste management facilities, municipalities

Mitigation strategy – Recycling markets

Components required for delivery *(Brief description of action required)*	**Implementation lead** *(Entity responsible for completing)*	**Time to implement** *(Time required to implement)*	**Other key stakeholders** **(***Entities that need to be engaged)*
Provide incentive for public-private partnership for recycling facility development.	DEC	2-3 years	DEC, municipalities, solid waste management facilities
Legislation to require a minimum level of recycled content in certain products and packaging to support end markets.	Legislative	2-5 years	DEC, product manufacturers
Legislation and green procurement programs to require the use of recyclables (compost, construction aggregate, etc.) by State and local entities and those contracting with the government.	OGS; DEC	1-3 years	State agencies

Mitigation strategy – Recycling markets

Anticipated Benefits and Impacts	
Disadvantaged communities	Developing local markets supports the businesses that provide job opportunities and reduce pollution in disadvantaged communities (see other recommendations).
Health and co-benefits	Building local markets for materials reduces long distance truck traffic and associated health effects.
Just transition: businesses and industries, workers	Market development is critical to support the potential jobs in recycling and composting and will help support a just transition.
Other	

Mitigation strategy – Initiative #5: Biogas Use

Description:	Recognizing that some waste generation is unavoidable, determine limited and strategic best uses for energy produced from biogas/RNG derived from organic waste. Assess use in the waste transportation sector, electric co-location or cogeneration opportunities for energy/heat intensive industries and hard to electrify users. Utilize market value of the energy to support organics diversion and waste reduction initiatives. Align energy price analysis with funding needs for build-out of organics recycling infrastructure.		
Action type:	Legislative; Financial		
GHG reduction by 2030:	Medium	**GHG reduction by 2050:**	High
Cost and funding considerations:	$$; Stable, enhanced energy revenue will attract investment to aggressively manage methane in existing disposal facilities and existing and new organics recycling facilities.		
Ease of implementation:	Medium		
Example case studies:	CA Biomat (Bioenergy Feed-in Tariff Program – SB1122)		

Risks / Barriers to success	Possible mitigants
• Redirection of organics in MSW stream to new and existing digesters and compost facilities will require quantification of feedstock and facility capacity and locations. • Ability to attract enough fuel approximate to facilities/guarantee fuel availability. • Perception that new transmission infrastructure will be needed for biogas use.	• Alternative revenues at organics recycling facilities will allow lower tip fees to attract NY organics at competitive levels. • Identify solutions to collection/feedstock/capacity issues and establish template for accelerated construction of organics recycling facilities 2030-2050. • No significant new transmission infrastructure would be allowed to support additional biogas.

Mitigation strategy – Biogas Use

Components required for delivery *(Brief description of action required)*	**Implementation lead** *(Entity responsible for completing)*	**Time to implement** *(Time required to implement)*	**Other key stakeholders** **(***Entities that need to be engaged)*
Identify energy pricing model and conduct market-based study for waste-generated biogas. Provide funding mechanism to support organics recycling infrastructure.	NYSERDA; PSC; Utilities	2-5 years	Solid waste management facilities, utilities, municipalities, business community
Evaluate strategic and local uses of generated fuels, electricity, or other energy produced from biogas/RNG for essential needs during transition to electrification and other low-emissions energy sources. Stress fuel uses in the waste transportation sector, electric co-location or cogeneration opportunities for energy/heat intensive industries, and hard to electrify users. Example: resilient microgrid capacity.	NYSERDA; PSC; Utilities	2-5 years	Solid waste management facilities, utilities, municipalities, business community

Mitigation strategy – Biogas Use

Anticipated Benefits and Impacts	
Disadvantaged communities	Reduction and control of methane and other gases by the creation of new organics recycling infrastructure will reduce the potential impact on disadvantaged communities where disposal facilities are located.
Health and co-benefits	Specific infrastructure improvements will also provide enforceable emission controls of other pollutants to improve local air quality.
Just transition: businesses and industries, workers	Jobs will follow the construction and operation of new facilities. Organics management has potential to develop into a national industry of its own.
Other	Organics recycling facilities need a revenue source other than gate fees.

Mitigation strategy – Initiative #6: Waste reduction, reuse, and recycling

Description:	Reduce methane and carbon dioxide emissions from waste disposal facilities by supporting robust waste reduction, reuse, and recycling initiatives.		
Action type:	Legislative; Financial		
GHG reduction by 2030:	Medium	**GHG reduction by 2050:**	Medium
Cost and funding considerations:	$; The cost is very low compared to other solid waste initiatives. Reuse centers also assist those in need as a low or no cost source for household goods, etc. Repair cafes assist people in maintaining their household goods.		
Ease of implementation:	Easy		
Example case studies:			

Risks / Barriers to success	Possible mitigants
• Having sufficient funding to establish and operate. • A Business Plan and administrator for a broader statewide networking/franchising system is challenging.	• A consistent and sufficient funding source will lead to greater success. • Energized grass roots volunteer, non-profit, and faith-based organizations already exist to implement.

Mitigation strategy – Waste reduction, reuse, and recycling

Components required for delivery *(Brief description of action required)*	**Implementation lead** *(Entity responsible for completing)*	**Time to implement** *(Time required to implement)*	**Other key stakeholders** (*Entities that need to be engaged)*
Require a surcharge (fee per ton) on all waste landfilled or combusted in New York State and all waste generated in New York State being sent for landfilling or combustion out-of-state to provide financial support for reduction, reuse, and recycling projects.	Legislative	1-2 years	DEC, solid waste management facilities, municipalities
Financial assistance to support waste reduction and reuse education and program implementation.	DEC	1-3 years	Municipalities, schools
Financial support for local reuse centers, materials exchanges/sharing hubs, certain repair shops, and innovative businesses incorporating recovered or waste reducing materials and technologies. (There is a big need to move beyond volunteer-run only operations.)	DEC	1-3 years	Municipalities, non-profit charities
Legislation to require “By Request Only” policies for single-use (e.g., cutlery, straws, etc.) products at businesses.	Legislative; DEC	1-2 years	Municipalities, businesses

Mitigation strategy – Waste reduction, reuse, and recycling

Components required for delivery *(Brief description of action required)*	**Implementation lead** *(Entity responsible for completing)*	**Time to implement** *(Time required to implement)*	**Other key stakeholders** **(***Entities that need to be engaged)*
Support innovative zero-waste product development and business projects.	Legislative	1-3 years	Businesses
Require textile origination/conditions of manufacture labeling and reduced sales of textiles; reduce import of GHG intensive and polluting textiles into NYS; optimize and reduce retail stocking; consumer-facing labeling on clothes and in stores; standardize eco-friendly clothing certification based on GHGs and pollutants.	DEC	2-5 years	Clothing retailers/industry
Support and expand successful recyclables collection programs inclusive of multi-family buildings and public housing (e.g., NYCHA, etc.). Use best available save as you throw programs, with consumer education in buildings.	DEC; housing authorities	1-3 years	Municipalities

Mitigation strategy – Waste reduction, reuse, and recycling

Components required for delivery *(Brief description of action required)*	**Implementation lead** *(Entity responsible for completing)*	**Time to implement** *(Time required to implement)*	**Other key stakeholders** **(***Entities that need to be engaged)*
Require reusable/refillable options for consumer goods in retail stores. Support the reduction and eventual elimination of single-use packaged items for use in stores. Implement deposit container programs where feasible. Require the sale of reusable diapers and feminine hygiene products in stores that choose to sell their disposable counterparts. Expand this to all personal care products, including toothpaste, soap, shampoo, etc.	Legislative	5 years	Businesses
Support digital demand software/technologies to monitor and reduce over-production across all sectors with comprehensive, measurable, and equitable regulation and inspection, inclusive of food, livestock & pets, home goods, hygiene and health products, restaurant goods, textiles, and all other consumer goods.	Legislative	1-4 years	Retailers, Manufacturers

Mitigation strategy – Waste reduction, reuse, and recycling

Components required for delivery *(Brief description of action required)*	**Implementation lead** *(Entity responsible for completing)*	**Time to implement** *(Time required to implement)*	**Other key stakeholders** **(***Entities that need to be engaged)*
Fund infrastructure development (i.e., eco-hubs) to increase access to reuse and recycling opportunities for multi-family housing and campuses (e.g., NYCHA, business parks, etc.). Facilities consist of Reverse Vending Machines (RVM), inclusive of MGP, e-waste, textile, organics, reuse programs, and non-traditional recyclable items.	DEC; ESD; HCR	3-5 years	NYCHA, housing authorities, municipalities
Implement new and expand existing statewide campaigns for reduction, reuse, and recycling (e.g., tv, hulu, spotify, radio and podcasts, billboards, subways, social media, other forms of media).	DEC	2-3 years	NYSAR3, media companies, SUNY ESF
Support peer-to-peer education and outreach campaigns in underperforming and BIPOC communities around reduction, reuse, and recycling.	DEC	1-3 years	EJ communities, municipalities, schools

Mitigation strategy – Waste reduction, reuse, and recycling

Components required for delivery *(Brief description of action required)*	**Implementation lead** *(Entity responsible for completing)*	**Time to implement** *(Time required to implement)*	**Other key stakeholders** **(***Entities that need to be engaged)*
Support coordination between local and regional municipalities to enhance regional recycling initiatives. Provide funding to hire local enforcement officers for municipal recycling programs. Encourage cross-jurisdiction and multi-planning unit collaboration on these efforts (e.g., Hudson Valley Regional Council Materials Management Committee).	Legislative; DEC	1-3 years	Municipalities, planning units
Require government procurement standards for low GHG-emitting products (e.g., textiles, paper, packaged products, etc.).	OGS; DEC	1-3 years	State agencies
Evaluate the feasibility of requiring universal restaurant reusables (unbranded) which can be used across establishments, with a deposit for use and drop off locations.	DEC	1-3 years	Restaurants

Mitigation strategy – Waste reduction, reuse, and recycling

Components required for delivery *(Brief description of action required)*	**Implementation lead** *(Entity responsible for completing)*	**Time to implement** *(Time required to implement)*	**Other key stakeholders** **(***Entities that need to be engaged)*
Support workforce development, job training and trades skills in repair, refurbishment, remanufacturing, recycling, and innovative materials reuse. (Example case study: NY Youth Works @ DOL)	ESD; NYSERDA; DOL	1-3 years	DEC, businesses, non-profit charities, municipalities
Evaluate the feasibility of requiring reusable shipping containers and padding to replace packaging material from online retailers.	Legislative	1-3 years	DEC, online retailers

Mitigation strategy – Waste reduction, reuse, and recycling

Anticipated Benefits and Impacts	
Disadvantaged communities	Education on waste reduction can have a positive financial impact on EJ and disadvantages communities. Local reuse centers can be a source for free or low-cost household items. Repair cafes help individuals keep their household items working, reducing the need to purchase new appliances, etc. Reuse centers and sharing platforms offer free or low-cost household items to those who cannot afford to buy new or have the space to own. Reduces waste, builds equity, and reduces the need to buy new.
Health and co-benefits	Less materials produced leads to less pollution and waste from product manufacturing.
Just transition: businesses and industries, workers	Job training workshops and education will benefit people looking for work in disadvantaged communities. Repair shops can be a source of local employment. Funding/moving away from volunteer-run organizations and employing people to run reuse centers, etc. will improve local employment.
Other	Many examples of successful programs exist.

Mitigation strategy – Initiative #7: WRRF Conversion

Description:	Transform Wastewater Treatment Plants from waste disposal priority to Water Resource Recovery Facilities (WRRFs) that emphasize capture of beneficial products		
Action type:	Financial		
GHG reduction by 2030:	High	**GHG reduction by 2050:**	High
Cost and funding considerations:	$$; WRRFs are a key component of the circular economy and present tremendous opportunities for reducing GHG emissions; however, their funding is tied to water and sewer rates, is generally constrained, and is largely dedicated to water quality projects. Additional funding streams will be necessary to unlock the GHG reduction potential of wastewater and its associated infrastructure.		
Ease of implementation:	Medium		
Example case studies:			

Risks / Barriers to success	Possible mitigants
• Difficult to self-fund projects due to water quality priorities and water/sewer rate affordability considerations. • Capital investments needed to maintain state-of-good-repair in addition to new resource recovery approaches. • Market conditions and regulations favor landfilling biosolids/digestate over beneficial reuse. • Evaluate extent and impact of co-pollutants such as emerging contaminants.	• Bioproducts resulting from resource recovery can be valuable if markets are aligned with GHG reduction priorities. • Incentivizing biogas production and utilization can offset costly infrastructure upgrades. • Current infrastructure has existing capacity to digest difficult-to-compost organics. • Many municipalities are working towards this goal and would benefit from additional State-level support.

Mitigation strategy – WRRF Conversion

Components required for delivery *(Brief description of action required)*	**Implementation lead** *(Entity responsible for completing)*	**Time to implement** *(Time required to implement)*	**Other key stakeholders** **(***Entities that need to be engaged)*
Support beneficial use of biosolids: Current market conditions often result in municipalities landfilling treated biosolids, losing the finite resources to landfills. Rising landfilling prices may push some municipalities to beneficially reuse naturally, but others that have agreements with local landfills and will require additional incentives to transition to beneficial reuse. Emerging technologies may make nitrogen, phosphorus and other nutrient separation and recovery economically feasible.	Local utilities; Municipalities	2-10 years	DEC; landowners and farmers; agriculture sector
Support beneficial use of renewable biogas, recognizing that water treatment process waste generation is unavoidable**:** Existing treatment plants have high thermal demands to operate digesters used to stabilize sludge. Boilers and engines on site are often able to replace natural gas with a WRRF's own digester gas. Some facilities may be well situated to provide local communities and co-located facilities with limited but strategic quantities of RNG.	Local utilities; Municipalities	2-10 years	DEC; engineering consultants; energy utilities

Mitigation strategy – WRRF Conversion

Components required for delivery *(Brief description of action required)*	**Implementation lead** *(Entity responsible for completing)*	**Time to implement** *(Time required to implement)*	**Other key stakeholders** **(***Entities that need to be engaged)*
Operate co-digestion programs with existing capacity: Anaerobic digesters with existing capacity should accept difficult-to-compost organics such as post-consumer food waste and FOG (Fats, Oils and Grease). Diverting additional organic wastes to WRRFs will require increased pre-processing and depackaging capacity throughout the state – either on- or off-site. Thickening improvements at WRRFs are low-capital investments that can increase capacity to operate co-digestion programs.	Local utilities	2 – 10 years	Local organics processors, haulers and microhaulers, DEC, waste preprocessing facilities

Mitigation strategy – WRRF Conversion

Anticipated Benefits and Impacts	
Disadvantaged communities	Reduced volume of biosolids sent to landfills will reduce methane, odors (particularly a concern where landfills that serve NY communities abut EJ communities); beneficial use of biogas can help grid-constrained areas by reducing utility demand or by exporting power or RNG, as well as sending RNG to difficult-to-electrify local buildings or businesses. This transformation will require investments in infrastructure that will be difficult to self-fund because of concerns with keeping water and sewer rates affordable.
Health and co-benefits	Beneficial reuse of biosolids has potential to offset synthetic, GHG intensive fertilizers, re-green space (tree plantings), and restore disturbed land.
Just transition: businesses and industries, workers	WRRFs will function as job creation hubs in the circular economy. Capturing non-renewable resources contained in wastewater (e.g., nitrogen, phosphorous) from treatment processes will require workforce training and permanent job creation. This will range from technical positions at the facility to distributed roles in communities to manage the resource streams made available.
Other	Nutrient recovery has the potential to offset large quantities of fossil fuel consumption if it replaces fertilizers containing atmospheric nitrogen (an energy intensive process) that takes place outside of NYS and is therefore not contained in the state inventory but contributes to climate change.

Mitigation strategy – Initiative #8: Fugitive emissions from WRRFs

Description:	Measure and reduce fugitive emissions from WRRFs, septic and sewer systems. Where density and local conditions allow, eliminate septic tanks and convert to municipal sewer system collections or advanced onsite treatments.		
Action type:	Legislative; Regulatory; Financial		
GHG reduction by 2030:	High	**GHG reduction by 2050:**	High
Cost and funding considerations:	$$. Larger municipal utilities may be able to absorb some costs, but medium and smaller municipalities do not have the funding to accomplish without state funding. Sewering costs will vary based on availability of a local WRRF and local soil conditions, among other factors. Funding will be critical to address wastewater GHG emissions; DEC regulations may need to be revised to require monitoring and remediation.		
Ease of implementation:	Easy to Medium, depending on emission source, funding available and monitoring capabilities.		
Example case studies:			

Risks / Barriers to success	Possible mitigants
• Monitoring of emissions can be difficult without proper equipment and training. • Difficult to quantify and address sewer emissions. • Nitrous oxide emissions profile of WRRFs is significant but poorly quantified. • Sewer conversions require proximity to a WRRF, and requires responsible entity, referendum, debt obligation, and high up front costs. • Private Property / Easement Access	• Some larger municipalities are already implementing these techniques and can provide guidance to others. • Abating methane fugitive emissions is primarily a financial issue not a technical feasibility issue. • Some communities have high septic costs because of soil conditions and may be willing to transition. • State funding could be repurposed to support this water quality and methane emission reduction improvements such as sewering.

Mitigation strategy – Fugitive emissions from WRRFs

Components required for delivery *(Brief description of action required)*	**Implementation lead** *(Entity responsible for completing)*	**Time to implement** *(Time required to implement)*	**Other key stakeholders** **(***Entities that need to be engaged)*
Capture and beneficially reuse fugitive biogas: Repair and consistently operate WRRF flares, boilers, engines, or other equipment on-site in order to prevent fugitive methane emissions. Evaluate captured biogas potential to identify strategic beneficial uses before flaring excess capacity.	Local utilities; Municipalities	6 months – 10 years	DEC, NYSERDA, EFC
Rulemaking and monitoring: Wastewater infrastructure was not always designed to mitigate GHG emissions and may require additional emissions monitoring rulemaking and oversight to implement. financial and procurement assistance to wastewater system operators is needed as well as job training to help stakeholders meet new air emission standards.	DEC; EFC; NYSERDA	1 – 2 years	Municipalities, local utilities

Mitigation strategy – Fugitive emissions from WRRFs

Components required for delivery *(Brief description of action required)*	**Implementation lead** *(Entity responsible for completing)*	**Time to implement** *(Time required to implement)*	**Other key stakeholders** **(***Entities that need to be engaged)*
Perform emissions monitoring and updated at WRRFs and septic systems.	DEC	6 months – 5 years	Local municipalities
Ensure proper maintenance of septic systems at the municipal level. Municipalities could establish a funding mechanism (paid for by homeowners) to allow contractual services for routine maintenance on septic systems (potentially legislation).	Municipalities	3 – 5 years	Home-owners, Septic system maintenance companies
Repurpose septic sewer assistance programs: Existing programs could be extended to include sewer hookups to defray high up-front costs of sewering.	EFC	1-5 years	NYSCDBG, NYSDOH, NYSDEC, NYSEFC, USDA-RD

Mitigation strategy – Fugitive emissions from WRRFs

Anticipated Benefits and Impacts	
Disadvantaged communities	Wastewater treatment plants are sometimes located in EJ and disadvantaged communities. Energy self-sufficiency at WRRFs can allow utilities to distribute finite renewable energy resources to other community needs.
Health and co-benefits	Emissions from wastewater treatment plants lead to odors and potential health impacts which have a significant impact on neighboring communities. Reducing these leaks will improve air quality in these communities. Proper maintenance of septic systems and septic conversions will improve surface and ground water quality.
Just transition: businesses and industries, workers	Local engineering, construction, and operation employment will be positively impacted by improving operations at these treatment facilities. These treatment plants are located throughout New York State, in large and small communities, providing widespread local employment opportunities.
Other	Reducing leaks will increase the amount of methane that is captured and can be used to generate renewable energy for use at the treatment plant and locally.

Mitigation strategy – Initiative #9: Refrigerant Diversion

Description:	Reduce GHG emissions associated with end-of-life management of appliances that contain High-Global Warming Potential refrigerants. Benefits are highest in the near-term while these refrigerants are still in widespread usage.		
Action type:	Legislative; Regulatory		
GHG reduction by 2030:	High	**GHG reduction by 2050:**	Medium
Cost and funding considerations:	$		
Ease of implementation:	Easy		
Example case studies:	EIA 100 Billion Ton Climate Problem (UK), EPA Part 608 implementation		

Risks / Barriers to success	Possible mitigants
• Wide range of manufacturers, products, and types of use of refrigerants. • Enforcement challenging due to the large number of end-of-life facilities. • Current lack of disposal data on these appliances.	• Many alternative refrigerants are being produced, but end-of-life management of existing appliances still remains important.

Mitigation strategy – Refrigerant Diversion

Components required for delivery *(Brief description of action required)*	**Implementation lead** *(Entity responsible for completing)*	**Time to implement** *(Time required to implement)*	**Other key stakeholders** *(Entities that need to be engaged)*
Require reclamation or destruction of refrigerants from appliances at end of life and institute requirements for verification and reporting.	DEC	1-5 years	Appliance manufacturers and producers, solid waste management facilities, auto repair
Imposing a ban on sale of virgin high-global warming potential (GWP) refrigerants for servicing with an exception for reclaimed refrigerants.	DEC	1-5 years	Appliance manufacturers and servicers
Extended Producer Responsibility program (see Initiative #2)	Legislative	1-5 years	
Create registry and reporting requirements (to track sales, stockpiles, and leaks) for large refrigeration and HVAC systems and refrigerant wholesalers and distributors.	Legislative; DEC	1-5 years	Appliance manufacturers and servicers, users such as supermarkets

Mitigation strategy – Refrigerant Diversion

Anticipated Benefits and Impacts	
Disadvantaged communities	HVAC and refrigeration equipment is important for human safety and resilience to climate change. Those who are most vulnerable may also be most affected transformations in this industry, including short-term price impacts driven by state and federal policy. Addressing leakage and disposal could mitigate costs.
Health and co-benefits	Proper management of refrigerant-containing appliances will decrease overall pollution from disposal of this material.
Just transition: businesses and industries, workers	Could lead to additional jobs related to service, recovery, and destruction of refrigerants from end-of-life appliances.
Other	These management techniques should be coupled with continued alternative refrigerant (replacement) research and production.

Enabling strategy summary

Description	Action type	Ease of implementation	Cost
Continue to research and obtain more accurate data on climate impacts from solid waste	Financial	Easy	$
Green, equitable jobs and workforce development. Institute coordination around workforce recruitment and employment frameworks. Develop strategies that result in a living wage green-collar labor system for residents and communities that are economically disadvantaged. Sustainable funding for environmental justice, resident-led initiatives with proven, shovel-ready (local and regional) solutions that reduce and divert recyclables and organics with a focus on multi-family buildings, disadvantaged, BIPOC, and underperforming communities.	Financial	Easy	$

Enabling initiative: Research

Description:	Continue to research and obtain more accurate data on climate impacts from solid waste
Action type:	Financial
Cost and funding considerations:	$; Costs associated with contracts with academic and consulting entities to perform research/pilot studies
Ease of implementation:	Easy
Example case studies:	

Risks / Barriers to success	Possible mitigants
• Obtaining and contracting in a timely manner • Applying research to existing mitigation strategies • Obtaining research results in time to implement to meet State climate goals • Limitations in available expertise in areas needed	• Contracting procedures already well understood • Some research already occurring on these topics • Timing to complete research should not be extensive

Enabling initiative: Research

Components required for delivery *(Brief description of action required)*	**Implementation lead** *(Entity responsible for completing)*	**Time to implement** *(Time required to implement)*	**Other key stakeholders** (*Entities that need to be engaged)*
Better understanding of potential co-pollutants from solid waste management and recycling facilities, including emerging contaminants.	DEC	1-3 years	Solid waste management facilities (SWMFs), academics, consultants
Development of lifecycle analysis model and solid waste management decision making tool.	DEC	1-3 years	SWMFs, academics, consultants
Research end of life management for difficult to manage materials (e.g., refrigerants, green energy infrastructure like solar panels, etc.).	DEC	1-3 years	NYSERDA, SWMFs, academics, consultants
Comprehensive landfill gas and water resource recovery facility emissions research study to evaluate emissions monitoring techniques, quantify fugitive emissions, and to evaluate most appropriate uses for the gas during transition to statewide electrification.	DEC	1-3 years	Landfills, academics, consultants, utilities
Market study of quantity and characteristics of organics (food waste, biosolids, other high strength waste) produced in state as well as possible end uses (agriculture, mine reclamation, roadside soil amendments and erosion control, etc.)	DEC	1-3 years	DAM, DOT, academics, consultants, SWMFs

Enabling initiative: Research

Anticipated Benefits and Impacts	
Disadvantaged communities	Better research on co-pollutants and other impacts from solid waste management facilities (SWMFs) that may be located in EJ communities and means to potentially mitigate issues affecting these communities.
Health and other co-benefits	Research on co-pollutants can help inform ways to eliminate health issues related to water and air pollution. Market research and development will assist SWMFs in effectively distributing product.
Just transition: businesses and industries, workers	Research projects lead to additional employment in engineering consultant firms and academic institutions.
Other	Emerging waste streams from clean energy efforts have not been previously studied or handled. Further research will help inform end-of-life management for these new wastes.

Enabling initiative: Green jobs

Description:	Green, equitable jobs and workforce development. Institute coordination around workforce recruitment and employment frameworks. Develop strategies that result in a living wage green-collar labor system for residents and communities that are economically disadvantaged. Sustainable funding for environmental justice, resident-led initiatives with proven, shovel-ready (local and regional) solutions that reduce and divert recyclables and organics with a focus on multi-family buildings, disadvantaged, BIPOC, and underperforming communities.
Action type:	Financial
Cost and funding considerations:	$
Ease of implementation:	Medium
Example case studies:	Inner City Green Team (NYC)

Risks / Barriers to success	Possible mitigants
	• See above recommendation about public/private funding mechanism for green jobs in waste • Thoughtfully easing restrictions for entrepreneurs in city and state agencies

Enabling initiative: Green jobs

Components required for delivery *(Brief description of action required)*	**Implementation lead** *(Entity responsible for completing)*	**Time to implement** *(Time required to implement)*	**Other key stakeholders** (*Entities that need to be engaged)*
Institute a job program aimed at recruiting recycling and sustainability champions and residents from multi-family buildings, disadvantaged communities, BIPOC, and underperforming communities.	DOL; Municipalities	1-3 years	Municipalities, workforce
Strengthen partnerships with local workforce development and staffing programs.	DOL; DSNY; NYCHA; upstate municipalities	1-3 years	Municipalities, workforce
Ensure funding consistent for program success.	DOL	1-3 years	Municipalities, workforce

Enabling initiative: Green jobs

Anticipated Benefits and Impacts	
Disadvantaged communities	Reduces economic disadvantages faced by such communities through creation of empowering workforce and job program co-led by people in community.
Health and other co-benefits	Creates heightened sense of community and solid waste management awareness.
Just transition: businesses and industries, workers	Strengthen partnerships with identified workforce development and staffing programs, which aims to attain job skills and better prepare working age residents for jobs that will increase earning and employment outcomes. Creates the model for economic opportunity and sustainable green-collar jobs with a living wage that improves quality of life.
Other	Empowers residents to take green action, and increase pride where they live.

Additional panel perspectives summary

Initiative	Summary of views
1; 7	Route at least 90% of organic waste to composting sites and facilities within 1-5 miles in cities, and 10 miles in less dense areas; Limited support for food waste routed as co-digestate to existing wastewater treatment facilities, up to 10% of organic waste stream, for local clean energy.
5	Encourage increased methane collection from landfills through an off-take or procurement program that compensates generators for reducing methane by combustion.
5	Off-take or procurement program for each kilo-watt hour (kWh) generated or thousand cubic feet (MCF) of pipeline gas produced; minimum price paid for compost products used in publicly funded projects.
N/A	Decommission NYS incinerators and end contracts out of state by 2030. Do not permit any subsidies, nor permit new incinerators, or incineration/burning by other names (inc. pyrolysis, gasification).
N/A	Establish polluter funded union jobs for cleanup and monitoring of natural and built environment (waterways and oceans, sewage, soils, air) to help all communities meet at least minimum legal environmental standards by 2035. Inclusive of but not limited to: fossil fuel companies, incinerators, plastic producers, single-use product producers, etc.

Additional panel perspectives summary (cont.)

Initiative	Summary of views
N/A	Improve the Management of Combined Sewer Overflows (CSOs) to prevent continued contamination during rain and storm events with comprehensive green and grey infrastructure. The NYS Department of Environmental Conservation (DEC) should require stronger application of green infrastructure strategies and nature-based solutions to increase the CSO capture rate. DEC should also better monitor compliance and require green infrastructure intervention in Municipal Separate Storm Sewer System (MS4) and direct drainage areas to decrease risk of pollutants reaching our waterways. Public investments in addressing CSOs should be coupled with strong maintenance strategies that support the local workforce goals, as well as public input and community awareness. Additionally, a strong CSO policy should incorporate resilient safe disposal and control of floatable and settleable trash and debris, alongside an improved street disposal and recycling plan.